**U.S. FISH AND WILDLIFE SERVICE**
**SPECIES ASSESSMENT AND LISTING PRIORITY ASSIGNMENT FORM**

SCIENTIFIC NAME: *Cyanea tritomantha*

COMMON NAME: 'Aku

LEAD REGION: Region 1

INFORMATION CURRENT AS OF: July 2005

STATUS/ACTION:

___ Species assessment - determined species did not meet the definition of endangered or threatened under the Act and, therefore, was not elevated to Candidate status

___ New candidate

_X__ Continuing candidate

___ Non-petitioned

__X_ Petitioned - Date petition received: May 11, 2004

_ 90-day positive - FR date:

_X_ 12-month warranted but precluded - FR date: May 11, 2005

_N_ Did the petition request a reclassification of a listed species?

FOR PETITIONED CANDIDATE SPECIES:

a. Is listing warranted (if yes, see summary of threats below)? yes

b. To date, has publication of a proposal to list been precluded by other higher priority listing actions? yes

c. If the answer to a. and b. is "yes", provide an explanation of why the action is precluded. We find that the immediate issuance of a proposed rule and timely promulgation of a final rule for this species has been, for the preceding 12 months, and continues to be, precluded by higher priority listing actions. During the past 12 months, most of our national listing budget has been consumed by work on various listing actions to comply with court orders and court-approved settlement agreements, meeting statutory deadlines for petition findings or listing determinations, emergency listing evaluations and determinations and essential litigation-related, administrative, and program management tasks. We will continue to monitor the status of this species as new information becomes available. This review will determine if a change in status is warranted, including the need to make prompt use of emergency listing procedures. For information on listing actions taken over the past 12 months, see the discussion of "Progress on Revising the Lists," in the current CNOR which can be viewed on our Internet website (http://endangered.fws.gov).

___ Listing priority change

Former LP: ___

New LP: ___

Date when the species first became a Candidate (as currently defined): 1999

___ Candidate removal: Former LP: __

___ A – Taxon is more abundant or widespread than previously believed or not subject to

the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status.

___U – Taxon not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status due, in part or totally, to conservation efforts that remove or reduce the threats to the species.

___ F – Range is no longer a U.S. territory.

___ I – Insufficient information exists on biological vulnerability and threats to support listing.

___ M – Taxon mistakenly included in past notice of review.

___ N – Taxon does not meet the Act's definition of "species."

___ X – Taxon believed to be extinct.

ANIMAL/PLANT GROUP AND FAMILY: Flowering plants, Campanulaceae (Bellflower family)

HISTORICAL STATES/TERRITORIES/COUNTRIES OF OCCURRENCE: Hawaii, island of Hawaii

CURRENT STATES/ COUNTIES/TERRITORIES/COUNTRIES OF OCCURRENCE: Hawaii, island of Hawaii

LAND OWNERSHIP: The majority of this species occurs on Hawaii State lands, but populations are also located on Federal (Hawaii Volcanoes National Park) and private lands.

LEAD REGION CONTACT: Paul Phifer, 503-872-2823, paul_phifer@fws.gov

LEAD FIELD OFFICE CONTACT: Pacific Islands Fish and Wildlife Office, Christa Russell, 808-792-9400, christa_russell@fws.gov

BIOLOGICAL INFORMATION:

Species Description *Cyanea tritomantha* is a palm-like tree 1.8 to 3 meters (m) (6 to 10 feet (ft)) tall. Leaves are oblong to oblanceolate or obovate, with blades 38 to 95 centimeters (cm) (15 to 37 inches (in)) long and 11 to 20 cm (4.3 to 7.9 in) wide, the upper surface green and glabrous, and the lower surface pale green and pubescent with sharp projections along the midrib. Inflorescences are 5 to 20-flowered and clustered among the leaves. The hypanthium is obconical, 10 to 14 millimeters (mm) (4.3 to 7.9 in) long, and 5 to 8 mm (0.2 to 0.3 in) wide. The calyx lobes are narrowly triangular, 1 to 25 mm (0.04 to 1.0 in) long, and 1.5 to 3 mm (0.06 to 0.12 in) wide. The corolla is blackish purple or greenish white externally, pale bluish white within, 60 to 75 mm (2.4 to 3.0 in) long, 5 to 6 mm (0.2 to 0.24 in) wide, and densely pubescent. Berries are orange, ellipsoid, 15 to 25 mm (0.6 to 1.0 in) long, 10 to 22 mm (0.4 to 0.9 in) in diameter, and crowned by the persistent calyx lobes (Lammers 1999).

Taxonomy *Cyanea tritomantha* was described by Asa Gray. This species is recognized as a distinct taxon in Lammers (1999) and Wagner and Herbst (2003) the most recently accepted Hawaiian plant taxonomy.

Habitat *Cyanea tritomantha* is found in closed *Metrosideros-Cibotium* montane wet forest with associated species *Broussaisia arguta, Cheirodendron trigynum, Dicranopteris linearis, Freycinetia arborea, Peperomia* sp., *Pipturus albidus, Psychotria* sp., *Rubus hawaiiensis,* and *Urera glabra,* at elevations between 408 to 1,499 meters (1,340 to 4,920 feet). It is also found in *Acacia-Metrosideros* lowland wet forest with *Antidesma* sp., *Athyrium sandwichianum, Cibotium* sp., *Cyanea pilosa, C. tritomantha, Cyrtandra* sp., *Hedyotis terminalis, Perrottetia sandwicensis, Pritchardia* sp., *Psychotria* sp., *Rubus rosifolius,* and *Trematolobelia macrostachys,* at elevations between 610 to 853 meters (2,000 to 2,800 feet) (Hawaii Natural Heritage Program Database 2004).

Historical and Current Range/Current Status This species is known from four to five populations totaling 100 to 500 individuals in Olaa and Kau on the island of Hawaii (Bill Garnett, private consultant, pers. comm. 1996; Jim Jacobi and Rick Warshauer, U.S.G.S. Biological Resources Discipline, pers. comms. 1996; Steve Perlman, National Tropical Botanical Garden, pers. comm. 1996; Linda Pratt, U.S.G.S. Biological Resources Discipline, pers. comm. 2005).
THREATS:

A. The present or threatened destruction, modification, or curtailment of its habitat or range.
Pigs (*Sus scrofa*) are a major threat to *Cyanea tritomantha* (B. Garnett, pers. comm. 1996; S. Perlman, pers. comm. 1996; R. Warshauer, pers. comm. 1996). As early as 1778, European explorers introduced livestock, which became feral, increased in number and range, and caused significant changes to the natural environment of Hawaii. Past and present activities of introduced alien mammals are the primary factor altering and degrading vegetation and habitats on the island of Hawaii. The pig is originally native to Europe, northern Africa, Asia Minor, and Asia. European pigs, introduced to Hawaii by Captain James Cook in 1778, became feral and invaded forested areas, especially wet and mesic forests and dry areas at high elevations. They are currently present on the island of Hawaii and four other islands, and inhabit rain forests and grasslands. While rooting in the ground in search of the invertebrates and plant material they eat, feral pigs disturb and destroy vegetative cover, trample plants and seedlings, and threaten forest regeneration by damaging seeds and seedlings. They disturb soil and cause erosion, especially on slopes. Alien plant seeds are dispersed on their hooves and coats as well as through their digestive tracts, and the disturbed soil is fertilized by their feces, helping these plants to establish. Pigs are a major vector in the spread of many introduced plant species (Smith 1985; Stone 1985; Medeiros *et al*. 1986; Scott *et al*. 1986; Tomich 1986; Cuddihy and Stone 1990; Wagner *et al*. 1999a). Pig exclusion fences protect two of the known populations of this species; however, without continued monitoring and maintenance of those fences, pigs from surrounding areas can easily access fenced areas. In addition, the remaining, unfenced individuals of this taxon are still impacted by this threat.

B. Overutilization for commercial, recreational, scientific, or educational purposes.
None known.

C. Disease or predation.
Rats and slugs are a threat to other members of this genus, and therefore are a potential threat to

this species (R. Warshauer, pers. comm. 1996; S. Perlman, pers. comm. 1996; B. Garnett, pers. comm. 1996). Currently, there are no control methods being implemented for these threats.

Of the four species of rodents that have been introduced to the Hawaiian Islands, the species with the greatest impact on the native flora and fauna is probably *Rattus rattus* (black or roof rat), which now occurs on all the main Hawaiian Islands. Black rats, and to a lesser extent *Mus musculus* (house mouse), *R. exulans* (Polynesian rat), and *R. norvegicus* (Norway rat), eat the fruits of some native plants, especially those with large, fleshy fruits. Many native Hawaiian plants produce fruit over an extended period of time, thus producing a prolonged food supply for rodent populations. Black rats strip bark from some native plants, and eat the fleshy stems and fruits of plants in the bellflower and African violet families (Tomich 1986; Cuddihy and Stone 1990; Joel Lau, Hawaii Natural Heritage Program, pers. comm. 1994). Rat damage to the stems of species of *Cyanea* has been reported in the wet forests of Kauai.

Little is known about the predation of certain rare Hawaiian plants by slugs. Indiscriminate predation by slugs on plant parts of the related *Cyanea remyi* has been observed by field botanists (Loyal Mehrhoff, U.S. Fish and Wildlife Service (Service), pers. comm. 1994; S. Perlman, pers. comm. 1994). The effect of slugs on the decline of this and related species is unclear, although slugs may pose a threat by feeding on the stems and fruit, thereby, reducing the vigor of the plants and limiting regeneration. Outplanted seedlings of the closely related genus *Clermontia* have been completely removed by slugs (Alvin Yoshinaga, University of Hawaii's Lyon Arboretum, pers. comm. 1995).

D. <u>The inadequacy of existing regulatory mechanisms</u>.
Pig hunting is allowed on all islands either year-round or during certain months, depending on the area (Hawaii Department of Land and Natural Resources n.d.-a, n.d.-b, n.d.-c). However, public hunting does not adequately control the number of ungulates to eliminate this threat to native plant species. Pig exclusion fences protect two of the known populations of this species; however, without continued monitoring and maintenance of those fences, pigs from surrounding areas can easily access fenced areas. In addition, the remaining, unfenced individuals of this taxon are still impacted by this threat.

E. <u>Other natural or manmade factors affecting its continued existence</u>.
Alien plant species threaten this species (R.Warshauer, pers. comm. 1996; S. Perlman, pers. comm. 1996; B. Garnett, pers. comm. 1996). Although the exact pest species that threaten this plant have not been identified, alien pest plants are found throughout the areas where this species occurs. The original native flora of Hawaii consisted of about 1,400 species, nearly 90 percent of which were endemic. Of the total native and naturalized Hawaiian flora of 1,817 taxa, 47 percent were introduced from other parts of the world, and nearly 100 species have become pests (Smith 1985; Wagner *et al*. 1999a). Confirmed personal observations (R.Warshauer, pers. comm. 1996; S. Perlman, pers. comm. 1996; B. Garnett, pers. comm. 1996) and several studies (Cuddihy and Stone 1990; Wood and Perlman 1997; Robichaux *et al*. 1998) indicate nonnative plant species may outcompete native plants similar to *Cyanea tritomantha*. Competition may be for space, light, water, or nutrients, or there may be a chemical inhibition of other plants (Smith 1985; Cuddihy and Stone 1990). In addition, nonnative pest plants found in habitat similar to

that of this species have been shown to make the habitat less suitable for native species (Smathers and Gardner 1978; Smith 1985; Loope and Medeiros 1992; Medeiros *et al.* 1992; Ellshoff *et al.* 1995; Meyer and Florence 1996; Medeiros *et al.* 1997; Loope *et al*. 2004). In particular, alien pest plant species modify habitat by modifying availability of light, altering soil-water regimes, modifying nutrient cycling, or altering fire characteristics of native plant communities (Smith 1985; Cuddihy and Stone 1990; Vitousek *et al*. 1987). Because of demonstrated habitat modification and resource competition by nonnative plant species in habitat similar to the closed *Metrosideros-Cibotium* montane wet forest habitat of *C. tritomantha*, the Service believes nonnative plant species are a threat to *C. tritomantha*. Nonnative plants are being controlled in two of the known populations of this species, but will probably never be completely eradicated because new propagules are constantly being dispersed into the fenced area from surrounding, unmanaged lands. Currently, many widespread alien plant taxa cannot be completely eradicated from the island of Hawaii, and therefore are expected to continue dispersing into previously managed areas (Loope 1998, Smith 1985). The remaining unmanaged populations of *C. tritomantha* are still impacted by this threat.

Some *Cyanea tritomantha* are locacted near trails used by hunters, and trampling of individual plants has been noted as a problem (J. Jacobi, pers. comm. 1996). We are unaware of any additional information documenting the destruction or decline of this species and, therefore, human trampling remains a potential threat to individuals of this species near trails.

CONSERVATION MEASURES PLANNED OR IMPLEMENTED

The populations *Cyanea tritomantha* within Olaa Tract of Hawaii Volcanoes National Park have been fenced, ungulates have been removed, and reintroduction efforts are ongoing (L. Pratt, pers. comm. 2005). The Olaa-Kilauea Partnership has received Service funds (through the Hawaiian Silversword Foundation) to restore native forest to areas previously grazed by cattle within Kulani Correctional Facility. Restoration includes fencing to exclude ungulates, weed control, and propagation and outplanting of native plants (Olaa-Kilauea Partnership 2005).

SUMMARY OF THREATS

The major threats to this taxon are pigs and nonnative plant species. Rats and slugs are a potential threat. Individuals of this species that occur near hunter trails are potentially threatened by human trampling. Feral pigs have been fenced out of two of the populations where *Cyanea tritomantha* currently occurs, but the fences must be continually maintained to prevent incursion. Nonnative plants have been reduced in the two populations that are fenced. These on-going conservation efforts for this species benefit only two of the known populations. The unmanaged populations are still impacted by these threats. Long-term monitoring and management will be required to maintain threat free areas.

LISTING PRIORITY:

| THREAT | | | |
|---|---|---|---|
| Magnitude | Immediacy | Taxonomy | Priority |
| | | | |

| | | | |
|---|---|---|---|
| **High** | **Imminent** | Monotypic genus | 1 |
| | | **Species** | **2*** |
| | | Subspecies/population | 3 |
| | Non-imminent | Monotypic genus | 4 |
| | | Species | 5 |
| | | Subspecies/population | 6 |
| Moderate to Low | Imminent | Monotypic genus | 7 |
| | | Species | 8 |
| | | Subspecies/population | 9 |
| | Non-imminent | Monotypic genus | 10 |
| | | Species | 11 |
| | | Subspecies/population | 12 |

**Rationale for listing priority number**:

*Mgnitude:*

This species is highly threatened by pigs that degrade and destroy habitat and by nonnative plants that outcompete and displace it. Potential threats to this species include rats and slugs that may directly prey upon individuals and human trampling of individuals located near trails. These threats to montane and lowland wet forest habitat of *Cyanea tritomantha* and to individuals of this species occur throughout its range, and are expected to continue or increase without their control or eradication. Feral pigs have been fenced out of two of the populations where *Cyanea tritomantha* currently occurs, but the fences must be continually maintained to prevent incursion. Nonnative plants have been reduced in the two populations that are fenced. These on-going conservation efforts for this species benefit only two of the known populations. The unmanaged populations are still impacted by these threats. Long-term monitoring and management will be required to maintain threat free areas.

*Iminence:*

Threats to *Cyanea tritomantha* from pigs, rats, slugs, and nonnative plants are imminent because they are ongoing.

Yes Have you promptly reviewed all of the information received regarding the species for the purpose of determining whether emergency listing is needed?

Is Emergency Listing Warranted? No. The species does not appear to be appropriate for emergency listing at this time because the immediacy of the threats is not so great as to imperil a significant proportion of the taxon within the time frame of the routine listing process. In addition, a non-profit organization has partnered with the Service to restore native lowland dry and wet forest habitat on the island of Hawaii. These conservation actions include ungulate exclosure fencing, nonnative plant removal, and outplanting, which benefit individuals of *Cyanea tritomantha* and other species. If it becomes apparent that the routine listing process is not sufficient to prevent large losses that may result in this species' extinction, then the emergency rule process for this species will be initiated. We will continue to monitor the status of *C. tritomantha* as new information becomes available. This review will determine if a change

in status is warranted, including the need to make prompt use of emergency listing procedures.

DESCRIPTION OF MONITORING

Much of the information in this form is based on the results of a meeting of 20 botanical experts held by the Center for Plant Conservation in December of 1995 and November 1996, and was updated by personal communication with Jim Jacobi and Rick Warshauer, U.S.G.S. Biological Resources Discipline, in 1996; Steve Perlman, National Tropical Botanical Garden, in 1994 and 1996; Bill Garnett, personal consultant, in 1995; Joel Lau, Hawaii Natural Heritage Program, in 1994; Loyal Mehrhoff, Service, in 1994; and Alvin Yoshinaga, Lyon Arboretum, in 1995. We have incorporated additional information on this species from our files and the most recent supplement to the *Manual of the Flowering Plants of Hawaii* (Wagner and Herbst 2003). In 2004, the Pacific Islands office contacted the following species experts: Bob Hobdy, retired from Hawaii Division of Forestry and Wildlife; Joel Lau, Hawaii Natural Heritage Program; Art Medeiros, U.S.G.S. Biological Resources Discipline; Hank Oppenheimer, resource manager for Maui Land and Pineapple Company; and Steve Perlman and Ken Wood, National Tropical Botanical Garden. No new information was provided in 2004. In 2005 we contacted the species experts listed below, and confirmation of the status of *Cyanea tritomantha* was provided by Linda Pratt, U.S.G.S. Biological Resources Discipline.

The Hawaii Natural Heritage Program identified this species as critically imperiled (Hawaii Natural Heritage Program Database 2004). Based on the International Union for Conservation of Nature and Natural Resources Red Plant Data Book rarity categories, this species is recognized as Vulnerable (likely to be endangered unless threats to its survival are removed or reduced) by Wagner *et al.* (1999b).

One species expert provided new information confirming the status of the species this year and the results are included in this assessment.

COORDINATION WITH STATES

In October 2004 we provided the Hawaii Division of Forestry and Wildlife with copies of our most recent candidate assessments for their review and comment. Vickie Caraway, the State botanist, reviewed the information for this species and provided no additional information or corrections (V. Caraway, pers. comm. 2005).

LITERATURE CITED

List all experts contacted:

| Name | Date | Place of Employment |
|---|---|---|
| 1. Joel Lau | June 28, 2005 | Hawaii Natural Heritage Program |
| 2. Art Medeiros | June 28, 2005 | U.S.G.S. Biological Resources Discipline |
| 3. Jim Jacobi | June 28, 2005 | U.S.G.S. Biological Resources Discipline |
| 4. Rick Warshauer | June 28, 2005 | U.S.G.S. Biological Resources Discipline |
| 5. Hank Oppenheimer | June 28, 2005 | Maui Land and Pineapple Company |
| 6. Kapua Kawelo | June 28, 2005 | U.S. Army |
| 7. Dave Lorence | June 28, 2005 | National Tropical Botanical Garden |
| 8. Steve Perlman | June 28, 2005 | National Tropical Botanical Garden |

| | | |
|---|---|---|
| 9. Ken Wood | June 28, 2005 | National Tropical Botanical Garden |
| 10. Linda Pratt* | June 28, 2005 | U.S.G.S. Biological Resources Discipline |
| 11. Marie Bruegmann | July 13, 2005 | U.S. Fish and Wildlife Service |
| 12. Vickie Caraway | June 14, 2005 | Hawaii Division of Forestry and Wildlife |

*Provided new status information provided on this taxon in 2005

List all databases searched:

| Name | Date |
|---|---|
| 1. Hawaii Natural Heritage Program | 2004 |

Other resources utilized:


Center for Biological Diversity, Dr. Jane Goodall, Dr. E.O. Wilson, Dr. Paul Ehrlich, Dr. John Terborgh, Dr. Niles Eldridge, Dr. Thomas Eisner, Dr. Robert Hass, Barbara Kingsolver, Charles Bowden, Martin Sheen, the Xerces Society, and the Biodiversity Conservation Alliance. 2004. Hawaiian Plants: petitions to list as federally endangered species. May 4, 2004.

Cuddihy, L.W., and C.P. Stone. 1990. Alteration of native Hawaiian vegetation; effects of humans, their activities and introductions. Coop. Natl. Park Resources Stud. Unit, Hawaii. 138 pp.

Ellshoff, Z.E., D.E. Gardner, C. Wikler, and C.W. Smith. 1995. Annotated bibliography of the genus *Psidium*, with emphasis on *P. cattleianum* (strawberry guava) and *P. guajava* (common guava), forest weeds in Hawai`i. Cooperative National Park Resources Studies Unit, University of Hawaii. Technical Report 95.

Hawaii, Department of Land and Natural Resources. N.d.-a. Summary of Title 13, Chapter 123, Game mammal hunting rules, island of Oahu. Division of Forestry and Wildlife, Honolulu. 2 pp.

Hawaii, Department of Land and Natural Resources. N.d.-b. Summary of Title 13, Chapter 123, Game mammal hunting rules, island of Molokai. Division of Forestry and Wildlife, Honolulu. 2 pp.

Hawaii, Department of Land and Natural Resources. N.d.-c. Summary of Title 13, Chapter 123, Game mammal hunting rules, island of Maui. Division of Forestry and Wildlife, Honolulu. 2 pp.

Lammers, T.G. 1999. Campanulaceae: *In* Wagner, W.L., D.R. Herbst, and S.H. Sohmer, Manual of the Flowering Plants of Hawai'i. University of Hawaii Press and Bishop Museum Press, Honolulu. Bishop Mus. Spec. Publ. 97: 420-489.

Loope, L.L. and A.C. Medeiros. 1992. A new and invasive grass on Maui. Newsletter of the Hawaiian Botanical Society 31: 7-8.

Loope, L.L. 1998. Hawaii and Pacific Islands. Pp. 747-774. In: M.J. Mac, P.A. Opler, C.E. Puckett Haecker, and P.D. Doran (eds.). Status and Trends of the Nation's Biological Resources, Volume 2. U.S. Department of the Interior, U.S. Geological Survey, Reston, VA.

Loope, L., F. Starr and K. Starr. 2004. Management and research for protecting endangered Hawaiian plant species from displacement by invasive plants on Maui, Hawaii. Weed Technology 18: 1472-1474.

Medeiros, A.C., L.L. Loope, P. Conant and S. McElvaney. 1997. Status, ecology, and

management of the invasive plant, *Miconia calvescens* DC (Melastomataceae) in the Hawaiian Islands. Bishop Mus. Occas. Pap.48: 23-36.
Medeiros, A.C., L.L. Loope, T. Flynn, S.J. Anderson, L.W. Cuddihy, and K.A. Wilson. 1992. Notes on the status of an invasive Australian tree fern (*Cyathea cooperi*) in Hawaiian rain forests. American Fern Journal 82: 27-33.
Medeiros, A.C., Jr., L.L. Loope, and R.A. Holt. 1986. Status of native flowering plant species on the south slope of Haleakala, East Maui, Hawaii. Coop. Natl. Park Resources Stud. Unit, Hawaii, Techn. Rept. 59: 1-230.
Meyer, J.-Y. and J. Florence. 1996. Tahiti's native flora endangered by the invasion of *Miconia calvescens* D.C. (Melastomataceae). Journal of Biogeography 23: 775-781.
Olaa-Kilauea Partnership. 2005. Kulani pasture reforestation and habitat enhancement. Proposal funded by U.S. Fish and Wildlife Service Hawaii Community Conservation Initiative in 2005.
Robichaux, R., J. Canfield, F. R. Warshauer, L. Perry, M. Bruegmann, and G. Carr. 1998. Adaptive Radiation. Endangered Species Bulletin. November/December.
Scott, J.M., S. Mountainspring, F.L. Ramsey, and C.B. Kepler. 1986. Forest bird communities of the Hawaiian Islands: Their dynamics, ecology, and conservation. Studies in Avian Biology 9: 1-429. Cooper Ornithological Society, Los Angeles.
Smathers, G.A. and D.E. Gardner. 1978. Stand analysis of an invading firetree (*Myrica faya* Aiton) population, Hawai`i. Proceeding of the Second Conference on Natural Science, Hawaii Volcanoes National Park, pp. 274-288.
Smith, C.W. 1985. Impact of alien plants on Hawai`i's native biota: *In* Stone, C.P., and J.M. Scott (eds.), Hawai`i's Terrestrial Ecosystems: Preservation and Management. Coop. Natl. Park Resources Stud. Unit, Univ. Hawaii, Honolulu, pp. 180-250.
Stone, C.P. 1985. Alien animals in Hawai`i's native ecosystems: toward controlling the adverse effects of introduced vertebrates: *In* Stone, C.P., and J.M. Scott (eds.), Hawai'i's Terrestrial Ecosystems: Preservation and Management. Coop. Natl. Park Resources Stud. Unit, Univ. Hawaii, Honolulu, pp. 251-297.
Tomich, P.Q. 1986. Mammals in Hawai`i: A synopsis and notational bibliography. Bishop Museum Press, Honolulu. 375 pp.
Vitousek, P.M., C.M. D'Antonio, L.L. Loope, M. Rejnanek, and R. Westerbrooks. 1997. Introduced species: a significant component of human-caused global change. New Zealand Journal of Ecology 21(1): 1-16.
Wagner, W.L., D.R. Herbst, and S.H. Sohmer. 1999a. Manual of the Flowering Plants of Hawai`i, Bishop Mus. Spec. Publ. 97:1-1918. University of Hawaii Press and Bishop Museum Press, Honolulu.
Wagner, W.L., M.M. Bruegmann, and J.Q.C. Lau. 1999b. Hawaiian vascular plants at risk: 1999. Bishop Mus. Occas. Pap. 60: 1-58.
Wagner, W.L. and D.R. Herbst. 2003. Electronic supplement to the manual of flowering plants of Hawai'i, version 3.1. December 12, 2003. Available from the Internet. URL: http://rathbun.si.edu/botany/pacificislandbiodiversity/hawaiianflora/supplement.htm.
Wenkam, R. 1969. Kauai and the park country of Hawaii. Sierra Club, San Francisco. 160 pp.
Wood, K.R. and S. Perlman. 1997. Maui 14 plant survey final report. Submitted by National Tropical Botanical Garden, October, 1997.

APPROVAL/CONCURRENCE: Lead Regions must obtain written concurrence from all other Regions within the range of the species before recommending changes to the candidate list, including listing priority changes; the Regional Director must approve all such recommendations. The Director must concur on all 12-month petition findings, additions of species to the candidate list, removal of candidate species, and listing priority changes.

Approve: Acting _____ 11/16/05
Regional Director, Fish and Wildlife Service Date

_____

Concur: _____ August 23, 2006
Director, Fish and Wildlife Service Date

Do not concur: _____ _____
Director, Fish and Wildlife Service Date

Date of annual review: September 16, 2005
Conducted by: Marie M. Bruegmann, Pacific Islands FWO
Plant Recovery Coordinator

Comments:
PIFWO Review

Reviewed by: Christa Russell_____ Date: September 19, 2005
Plant Conservation Program Leader

Gina Shultz_____ Date: October 14, 2005
Assistant Field Supervisor,
Endangered Species

Patrick Leonard_____ Date: October 14, 2005
Field Supervisor